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POWERFUL CHEMICAL AGENT FOR USE AGAINST AGRICULTURAL PESTS AND DISEASES

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/A Digest/

Chemical agents which are effective against many or all of the numerous plant blights and pests without harming humans or animals have been replacing agents which are effective against only one or a small number of plant enemies. An outstanding example of these new "universal" insecticides is hexachlorocyclohexane (shortened name, "hexachlorane"), the formula for which is $C_6H_6Cl_6$.

Its gamma-isomer has a very high toxic quality, and has proved very effective against the majority of harmful insects: aphids, caterpillars, butterflies, larvae of various beetles, bed bugs, and even against "wire" worms, a species of earthworm against which the fight has been complicated by the difficulty of obtaining a sufficient quantity of an inexpensive chemical agent.

Large areas of young crops and forage grass were spared from damage by locusts through the use of hexachlorane in the summer of 1948 in the eastern and southeastern regions of the USSR. Moreover, it is anticipated that this chemical will attain considerable importance for use against malaria mosquitoes and carriers of other serious diseases. It can also be utilized in safeguarding forest plantings from harmful insects.

The chemistry and technology of hexachlorane were developed by the Scientific Research Institute of Fertilizers and Insectofungicides (NIUIF) along with the Chernorechenskiy Chemical Plant (ChKhZ). At present the agent is being used against scores of diseases, pests, parasites, and carriers which adversely affect plants.

This work was developed in line with Party directives on productivity, and the following men became Laureates of the Stalin Prize by virtue of their contributions to the project: Senior Scientific Contributors of NIUIF Yu. N. Bezobrazov, A. V. Molchanov, and V. I. Orlov; Chief of the General Laboratory of ChKhZ G. M. Strongin; plant director A. M. Klimakhin; and chief of a division of the Ministry of Agriculture A. M. Nikiforov.

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The starting materials for making hexachlorane are benzene and chlorine, both of which are plentiful, and its preparation is simple. These facts make it possible to produce an adequate supply at low cost. Essentially the reaction is as follows:

$$C_6H_6 + 3Cl_2 \rightarrow C_6H_6Cl_6.$$

Under the effect of light from mercury (ultraviolet) lamps, the reation is violently accelerated. This process proceeds continuously in either a glass or a lead column sprayed from above with benzene towards which the stream of chlorine is directed countercurrently. The reagents are exposed either from within or from without (through a glass window) to the light of mercury-quartz lamps.

Upon completion of the photochemical chlorination of benzene, the solution of hexachlorane is heated in order to distill off the unreacted benzene. The fused hexachlorane is then crystallized, and the crystals are washed and filtered. The product consists of at least 95 percent of hexachorocyclohexane, and should contain no less than 10 percent of the gamma-isomer and no more than 5 percent of water. The product is white or a light brown color and has the consistency of a greasy crystalline powder which readily forms easily friable lumps.

Hexachlorane is applied either as a dust in combination with a filler (such as talcum or kaolin) or as a concentrated emulsion. The latter is prepared by dissolving hexachlorane enriched with the gamma-isomer in mineral oil and then carefully mixing this with cellulose sulfite liquor in an apparatus of the colloidal mill type. This emulsion then contains up to 20 percent of hexachlorane, enriched with the gamma-isomer. The procedure for the preparation of the emulsion was developed in NIUIF by S. F. Bezugliy.

Before this emulsion is used in spraying, it is diluted with water to the concentration desired. Hexachlorane also can be used as a mist created by heating and sublimating. Combustible materials used for dispersing the material in this manner are charcoal sawdust, dry peat, and paper; saltpeter and Berthollet's salt are used as oxidizing agents.

This chemical was studied for extensive application in agriculture, public health and welfare, as well as for use by entomologists, phytopathologists, parasitologists, and medical men. Senior Scientific Contributor Ye. A. Pokrovskiy conducted a study of the toxic effect of this chemical on harmful insects.

At present hexachlorane is being produced in greater quantity than numerous other insecticides.

Foreign information relating to this product published in 1948 indicates that the technological procedure in the USSR is more practicable.

Bezobrazov and Molchanov have developed interesting improvements in the technological process which permit concentration of the toxic gamma-isomer and production of other organic end products of value. For example, these authors suggested the preparation (from nontoxic isomers of hexachlorane) of dinitrotrichlorobenzene, an agent useful in combating several diseases which affect valuable plants. Several other organic products can also be synthesized from the latter product. These authors suggested methods for eliminating the disagreeable odor of hexachlorane.

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